

Background

Particulate matter (PM) consists of both solid particles and liquid droplets, and is generally categorized according to the size of the particles. Particles that are approximately 10 micrometers (µm) or larger in diameter usually are trapped along a person's respiratory tract before reaching the lungs. Particles less than 10 µm can reach the lungs. Of greatest concern are particles less than 2.5 µm in diameter – referred to as fine particles or particulate matter (PM_{2.5}) – which can lodge deep inside the lungs.

Particles are either directly emitted into the air or formed during atmospheric reactions between substances such as sulfur dioxide (SO₂) and oxides of nitrogen (NO_x). Manmade sources of PM_{2.5} include various combustion processes (such as automobile engines), or fine particles can be produced naturally from gases released by plants and other organisms.

A number of studies have shown an association between concentrations of PM in the air and increased respiratory and cardiovascular health problems and mortality.¹ Groups that appear to be at the greatest risk from PM include children, the elderly, and individuals with heart and lung diseases, such as asthma.² In addition to health effects, PM is a major cause of reduced visibility in many parts of the United States. It can also affect vegetation and aquatic ecosystems and can damage buildings and materials.

Because fine particles have a significant impact on human health, they have received more attention recently from the EPA and the DEP.

In 1997, pursuant to the Clean Air Act, EPA issued new National Ambient Air Quality Standards (NAAQS) for PM_{2.5}. EPA set PM_{2.5} annual primary (health based) and secondary (welfare based) standards at 15µg/m³ and the 24-hour standard at 65µg/m³.³ Annual standards represent concentrations averaged over an entire year; 24-hour standards represent concentrations averaged over a 24-hour period. The 24-hour standard is higher, because unusual conditions could cause a short-term spike in concentrations. The EPA has declared that 13 New Jersey counties fail to attain these standards because PM_{2.5} levels in some regions of these counties exceed the annual standards. New Jersey is thus considered out of attainment with the PM_{2.5} standards. The state is committed to achieving the PM_{2.5} standards and is

in the process of developing a State Implementation Plan (SIP) that will describe how it will achieve the standards statewide. New Jersey has until 2008 to complete its SIP and must attain the standards by 2010.

In addition to controlling fine particulate matter to reduce health impacts, the State is working to lower airborne particle levels to improve visibility. Without the effects of pollution, the visual range in the Eastern United States under good weather conditions would be about 90 miles; but, due to the presence of fine particles, the current range is only an average of 14-24 miles.⁴

In April 1999, the federal Regional Haze Rule was promulgated. This rule calls for state and federal agencies to work together to improve visibility in 156 national parks and wilderness areas, including the Edwin B. Forsythe National Wildlife Refuge in Oceanville. The Interagency Monitoring of Protected Visual Environments (IMPROVE) program, the cooperative measurement effort managed by representatives from federal and regional-state organizations that was established in 1985, has been working on implementing the Regional Haze Rule. Each state must develop coordinated strategies and implement programs to reduce manmade emissions that contribute to haze. The goals are designed to reach natural conditions in 60 years.

Status and Trends

Monitoring

NJDEP monitors PM_{2.5} at 20 sites statewide, while DEP monitors smoke shade at 11 sites. Smoke shade is an indirect measure of particle concentrations.

In 2002, the annual average concentration of PM_{2.5} at the 20 monitoring sites ranged from 11.1 µg/m³ to 15.1 µg/m³. Only one site exceeded the annual standard of 15 µg/m³. In that year, all sites exceeded the 24-hour standard of 65 µg/m³ at least once. However, all of these were due to an unusual event – a large forest fire in the Hudson Bay region of Canada - that impacted New Jersey on July 7, 2002.

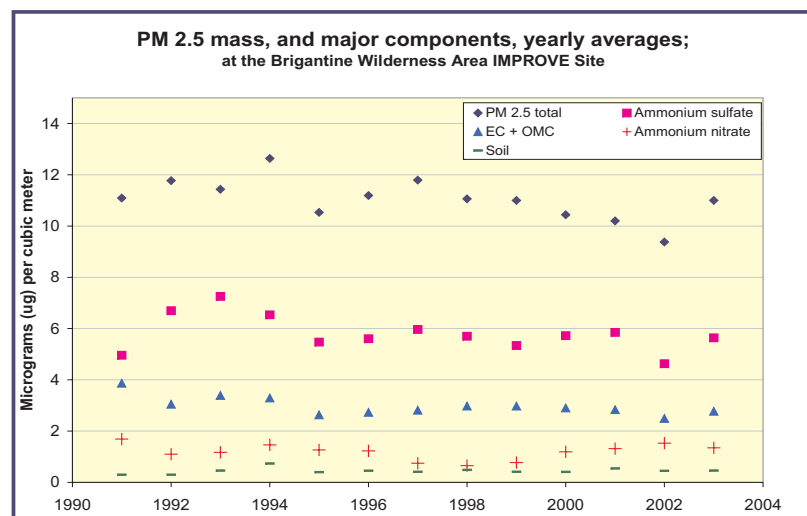
The monitoring of smoke shade since 1970 provides evidence of a consistent decline in particle concentrations in the state. In the early 1970s, the state's smoke shade reading was in the range of 1.2 coefficient of haze (COH), a

measurement that is based on how much light transmits through the air. Since the mid-1990s, however, it has consistently remained below 0.4 COH. Readings above 2.0 COH are considered unhealthy for sensitive groups according to DEP's Web-based Air Quality Index.⁴

In addition to monitoring $PM_{2.5}$ concentrations, the DEP also measures chemical composition of fine particles at four sites. In 2002, DEP found that organic carbon and sulfate combined to make up more than 60 percent of the total mass of fine particles in the air. Nitrate, ammonium, and elemental carbon made up an additional 38 percent.

IMPROVE program monitoring

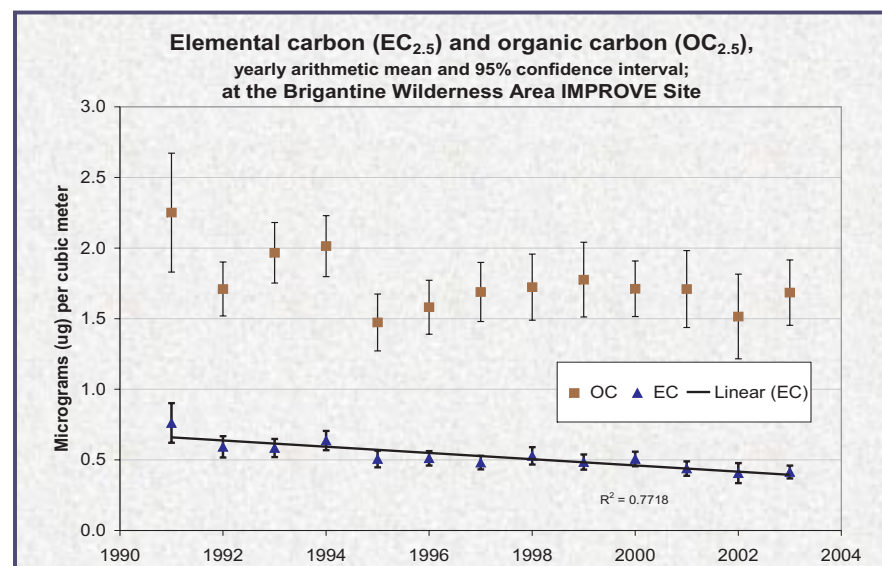
IMPROVE data provide a relatively long-term record of particle concentrations and particle chemical composition at the Brigantine Wilderness Area, where DEP is working with federal and regional partners to improve visibility (See figures below).



Although annual averages such as these can mask important seasonal characteristics and changes, they are of some value in identifying possible

trends. One trend that seems to exist is a decline in elemental carbon (EC) and organic carbon (OC) over time. A decline, although less pronounced, also seems to exist with ammonium sulfate.

The data for EC and OC are shown in the figure "Elemental Carbon (EC) and Organic Carbon (OC)..." below. EC shows a clear downward trend.



Outlook and Implications

A full three years of data are required to determine compliance with the national standard for $PM_{2.5}$. DEP will continue evaluating $PM_{2.5}$ data it collects to determine whether annual standards are being met.

There is some indication, based on the long-term downward trend in smoke shade readings and in the apparent downward trends in the IMPROVE data, that fine particle levels are improving in New Jersey. However, these apparent trends do not provide assurance that the standard of an annual average of 15 $\mu g/m^3$ will be achieved in all areas of the state. Further, levels at Brigantine are still high enough to degrade visibility. Fine particle levels in the air have a strong seasonal component; future efforts at long-term trend monitoring should take possible seasonal effects and weather variations into consideration.

There doesn't appear to be a level below which there are no adverse health impacts from PM_{2.5}. Therefore, regardless of whether New Jersey meets the current standard, it is important to reduce PM_{2.5} emission sources and concentrations. Therefore, New Jersey is determined to implement additional measures statewide, rather than just in the non-attainment areas.

More Information

For more information, visit www.state.nj.us/dep/airmon/, www.epa.gov/ebtpages/airairpoparticulatematterpm.html or www.hazecam.net. Information on the IMPROVE program is available at <http://vista.cira.colostate.edu/improve/>.

References

¹ PM – How Particulate Matter Affects the Way We Live and Breathe, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC November 2000, URL: www.epa.gov/air/urbanair/pm/index.html

² Environmental Health Threats to Children, USEPA, Office of the Administrator, EPA-176/F-96-001, September 1996.

³ Air Quality Criteria for Particulate Matter, USEPA, Office of Research and Development, EPA-600/P-99-002A and B, March 2001

⁴ <http://vista.cira.colostate.edu/improve/>, November 17, 2004.

⁵ See www.state.nj.us/dep/airmon